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(54) A process for the production of human antibodies.

(57) A process for producing human lymphocyte anti-cancer Recognin antibody wherein the cancer Recognin is a product, derived from cancerous tumour tissue or cells, which is characterized by forming a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, by being soluble in water and aqueous solutions and having a spectrophotometric absorption peak wave length of 280 mu and a molecular weight of from about 3,000 to 25,000, and further characterized by having an amino acid residue composition characterized by high proportions of glutamic and aspartic acids and high ratios of glutamic and aspartic acids to histidine comprising the steps of:

- a) obtaining a population of human lymphocyte cells;
- b) selecting a subpopulation of the population of human lymphocytes wherein the subpopulation produces anti-cancer Recognin antibody; and
- c) treating the subpopulation of anti-cancer Recognin antibody producing human lymphocytes in a manner effective to enhance anti-cancer Recognin antibody production.

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A PROCESS FOR THE PRODUCTION OF HUMAN ANTIBODIES

This invention relates to 1) the production of two products which are distinct species of human anti-Malignin antibody, and 2) the production of cells, which have the distinguishing characteristic of manufacturing different species of anti-Malignin antibody during different growth phases. The above products, both the antibodies themselves and the cells which produce them, are useful for diagnostic, metabolic and therapeutic purposes.

The process of cell fusion to produce hybrids is now a routinely used and accepted procedure (Monoclonal Antibodies, Cesar Milstein, Scientific American, May 1980, pp. 66-74). The production of antibodies by the injection of tumor cells into animals has also been a common procedure in the art for many years. U.S. Patent No. 4,172,124 issued to Hillary Koprowski and Carlo M. Croce discloses a method of producing antibodies to whole tumor cells. The critical first tumors step of the Koprowski et al. method is to inject whole cells from various tumors into an animal. The present invention does not utilize an injection of whole cells into an animal. Nor does the present invention require the use of an injection of a specific polypeptide composition, Malignin, the subject of my U.S. Patents Nos. 4,195,017 and 4,196,186, into an animal to produce the specific species of a specific antibody, anti-Malignin antibody as taught in my U.S. Patent 4,486,538. Whereas these patents describe the production of polyclonal anti-Malignin antibody in mammals and monoclonal anti-Malignin antibody in hybridomas, the anti-Malignin antibodies of the present invention are genetically human and monoclonal, but are not the products of hybridomas.

In addition to a different mode of production, as will be set forth herein, the present monoclonal antibodies have unique properties, and should therefore be uniquely referred to in order to  
5 distinguish them from the anti-Malignin antibody which is either polyclonal and produced in vivo in mammals, or monoclonal, but produced by hybridomas, and has different properties: i.e., the present antibodies are free of non-human antigenic  
10 determinates or epitopes.

Accordingly, the present invention provides a process for producing human lymphocyte anti-cancer Recognin antibody wherein the cancer Recognin is a product, derived from cancerous tumour tissue or  
15 cells, which is characterized by forming a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, by being soluble in water and aqueous solutions and having a spectrophotometric absorption peak wave length of 280 m $\mu$  and a molecular weight of from about 3,000 to 25,000, and further characterized by having an amino acid residue composition characterized by high proportions of glutamic and aspartic acids and high ratios of glutamic and aspartic acids to histidine comprising  
20 the steps of:  
25

- a) obtaining a population of human lymphocyte cells;
- b) selecting a subpopulation of the population of human lymphocytes wherein the subpopulation produces anti-cancer Recognin antibody; and
- c) treating the subpopulation of anti-cancer Recognin antibody producing human lymphocytes in a manner effective to enhance anti-cancer Recognin antibody

production.

The population of human lymphocytes may be obtained by a process comprising:

- 5           (i) surgical removal of a part of a spleen; and  
             (ii) isolating individual lymphocyte cells from  
             the spleen.

10          The population of human lymphocytes may also be obtained by separating viable lymphocytes from a blood sample which may be from donor who is not known to be suffering from a disease, or from a donor who is in the early stages of cancer and producing a large quantity of the anti-cancer Recognin antibody.

15          The process of the present invention may further comprise growing the lymphocytes in a cell culture.

20          The selection of a subpopulation of the anti-cancer Recognin antibody may comprise the testing of the lymphocyte cell culture media supernate for the presence of the anti-cancer Recognin antibody, for example by immunoabsorption of the antibody onto immobilized Recognin antigen.

25          The treatment of the subpopulation may be carried out by adding an effective amount of pokeweed mitogen to the lymphocyte cell culture, preferably at least about 10 µg/ml and more preferably at least about 20 µg/ml. Alternatively, the treatment step may comprise transforming the lymphocyte cell subpopulation, for example by EB virus.

30          The process of the invention may further comprise isolating the anti-cancer Recognin antibody by absorbing the anti-cancer Recognin antibody onto immobilized Recognin. The isolated anti-cancer Recognin may be modified by adding a chemotherapeutic agent to the antibody, or by adding a signal emitter to the antibody. Preferably the signal emitter is fluorescent, or creates a radiological contrast image

in a tissue environment, or is a nuclear magnetic resonance spin label.

In the process of the invention the cancer Recognin is preferably Malignin, although, it will be  
5 appreciated that the process of the present invention is also applicable to the production of other Recognins such as Astrocytin, Recognin L and Recognin M.

The present invention also includes within its scope a composition comprising human monoclonal anti-Malignin antibody-Fast or a purified fraction thereof, whereby the antibody or a purified fraction thereof attaches to cancerous cells, the cells comprising Malignin; and can thereby be detected by  
10 visible or signal-emitting means attached to the antibody, the Malignin being derived from brain tumour cells, and which forms a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, which is soluble in water and aqueous solution having an acid or neutral pH, and  
15 insoluble at an alkaline pH, and has a spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-  
20  
25

APPROXIMATE NO. OF RESIDUES

	Aspartic Acid	9
5	Threonine	5
	Serine	5
	Glutamic Acid	13
	Proline	4
	Glycine	6
	Alanine	7
10	Valine	6
	1/2 Cysteine	1
	Methionine	2
	Isoleucine	4
	Leucine	8
15	Tyrosine	3
	Phenylalanine	3
	Lysine	6
	Histidine	2
	Arginine	5
20		49

ammonia and the amino acids cysteic, hydroxyproline, norleucine, isodesmosine, lysinonorleucine and gamma-aminobutyric acid being absent in detectable amounts.

The present invention further includes within its scope a composition comprising human monoclonal anti-Malignin antibody-Slow or a purified fraction thereof, whereby the antibody or a purified fraction thereof attaches to cancerous cells, the cells comprising Malignin; and can thereby be detected by visible or signal-emitting means attached to the antibody, the Malignin being derived from brain tumour cells, and which forms a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel

5 diffusion tests, which is soluble in water and aqueous solution having an acid or neutral pH, and has a spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-

APPROXIMATE NO. OF RESIDUES

10	Aspartic Acid	9
	Threonine	5
	Serine	5
	Glutamic Acid	13
	Proline	4
15	Glycine	6
	Alanine	7
	Valine	6
	1/2 Cysteine	1
	Methionine	2
20	Isoleucine	4
	Leucine	8
	Tyrosine	3
	Phenylalanine	3
	Lysine	6
25	Histidine	2
	Arginine	5
		89

30 ammonia and the amino acids cysteic, hydroxyproline, norleucine, isodesmosine, lysinonorleucine and gamma-aminobutyric acid being absent in detectable amounts.

The present invention still further includes within its scope a composition comprising human monoclonal anti-Malignin antibody-Fast and Slow or a purified fraction thereof, whereby the antibody is cytotoxic to and kills the cancer cells, the cells

comprising Malignin, whereby the antibody or a purified fraction thereof attaches to cancerous cells and can thereby be detected by visible or signal-emitting means attached to the antibody, the  
 5 Malignin being derived from brain tumour cells, and which forms a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, which is soluble in water and aqueous solution having an acid or  
 10 neutral pH, and insoluble at a alkaline pH, and has an spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-

15

APPROXIMATE NO. OF RESIDUES

	Aspartic Acid	9
	Threonine	5
	Serine	5
20	Glutamic Acid	13
	Proline	4
	Glycine	6
	Alanine	7
	Valine	6
25	1/2 Cysteine	1
	Methionine	2
	Isoleucine	4
	Leucine	8
	Tyrosine	3
30	Phenylalanine	3
	Lysine	6
	Histidine	2
	Arginine	5
35		89

ammonia and the amino acids cysteic, hydroxyproline,

norleucine, isodesmosine, lysinonorleucine and gamma-aminobutyric acid being absent in detectable amounts.

Preferably the antibodies of the above described compositions are predominantly IgM.

5       The cell lines themselves, which have been produced by the present invention have the ability to produce human monoclonal anti-Malignin antibodies. These cell lines are unique in that a single (monoclonal) line or type of cell with an ability to 10      produce human monoclonal anti-Malignin antibody has been produced. Further, these novel cells lines can produce human monoclonal anti-Malignin antibody in perpetuity. This new cell therefore herewith designated human monoclonal anti-Malignin 15      antibody-producing-cells. These new cells have immediate utilities related to the patented utilities of their product antibody, i.e. diagnostic and therapeutic. Thus the earlier patents make clear both in their Specifications and their Examples the 20      diagnostic use of the antibody to detect the antigen Malignin, or any cell which contain Malignin, or to treat therapeutically (i.e. destroy) such cells, i.e. malignant or cancerous cells through the specific reaction of anti-Malignin antibody with its specific 25      antigen, Malignin, whether the antigen is in solution or fixed in cells or by attaching a cytotoxic agent to the antibody.

30      Additionally, a human cell producing anti-Malignin antibody may be isolated. Preferably, the human anti-Malignin antibody producing cell is a lymphocyte. The human lymphocyte producing anti-Malignin antibody may be either splenic or peripheral. Moreover, it is further preferred that the anti-Malignin antibody producing lymphocyte cell 35      is treated in a manner effective to increase the anti-Malignin antibody producing cell antibody

production rate beyond the cell's baseline antibody production rate.

In one embodiment of the present invention, the human lymphocyte producing anti-Malignin antibodies is treated with a material which stimulates antibody production. In another embodiment of the present invention, the anti-Malignin antibody producing lymphocyte is transformed into a cell capable of continuous growth and division. A single transformed anti-Malignin antibody producing cell and its progeny constitute a cell line producing monoclonal antibodies. The cell line may comprise cells which are transformed for example virally transformed. A virus which may transform such cells is the EB virus.

The present invention also includes within its scope the nucleic acids of the various novel cell lines produced in accordance with the process of the invention.

Two constituent species of anti-Malignin antibody were recognized early: 1) Fast Target-attaching-globulin (F-TAG) and 2) Slow Target-attaching-globulin (S-TAG) (Issued Patent Nos. 4,195,017 and 4,196,186). F-TAG combines rapidly i.e. in vitro, within 10 minutes with its specific immobilized antigen Malignin. S-TAG slowly combines i.e. in vitro within 2 hours, with its specific immobilized antigen Malignin. U.S. Patent No. 4,196,186 disclosed a cancer diagnostic test which was based on a determination of the concentration of S-TAG and F-TAG in blood serum of individuals. The disclosed method never yielded either antibody completely free of the other. The present invention discloses the production of unique cell which produces human F-TAG and human S-TAG at different phases in the cell line's growth cycle.

As summarized above, the ability of the previous

- 10 -

polyclonal anti-Malignin antibody, which contained both species, to destroy cancer cells specifically (cytotoxicity) was described in U.S. Patent No. 4,195,017. It was further found that either single species of monoclonal antibody product S-TAG, monoclonal anti-Malignin antibody-Slow (MAMA-S), and F-TAG, monoclonal anti-Malignin antibody-Fast (MAMA-F) preferentially attach to cancer cells, but neither single species will destroy cancer cells.

The species of combined human antibody here produced for the first time by monoclonal producer cells, designated HMAMA-FS, as well as an artificial mixture of the two antibodies HMAMA-S and HMAMA-F, preferentially attaches to and destroy cancer cells.

The separation of the attachment function from the destruction function of these species of anti-Malignin antibody has important applications for diagnosis and treatment (destruction) of cancer.

As previously described in my Patent Specifications, careful clinical studies of possible individual patients suffering from cancer has provided unequivocal data that patients who survive longer than one year -- 13 to 46 months -- have higher levels of anti-Malignin antibody than those patients who died within one year. Patients with low levels of the antibody were dead within one year. The link between survival and elevated serum levels of anti-Malignin antibody suggests therapeutic utility for this antibody.

Therefore, in light of the previous clinical studies showing that the serum level of anti-Malignin antibody is related to survival, it is important to have a supplemental antibody which is not rejected by the patient's immune system.

The present invention thus produces a human antibody, to Malignin and novel cell lines which are

capable of continuous growth and division thereby producing the specific, preferentially-attaching and cancer cell-destroying, human anti-Malignin antibodies in virtually limitless quantities. The  
5 products of this process therefore acquire an added significance as novel therapeutic anti-cancer products.

The novel cell lines of the present invention carry the permanent instruction in their generic  
10 apparatus to manufacture the particular human antibody product. Some of these cell lines also carry the instruction to continue to divide indefinitely. Both of these instructions are seen in the Examples herein. Those familiar with the art  
15 will recognize that the particular cellular constituents which carry this genetic information can be isolated and induced to perform their particular functions in the antibody manufacture in vitro, should this transfer be particularly useful. For  
20 example, should there by an efficiency, cost or other advantage to doing so, the nucleic acid of the producer cell which carries the specific information for manufacturing human monoclonal anti-Malignin antibody can now be removed and isolated from the  
25 other cellular constituents and inserted into another type of cell, such as a bacterial, which might divide more quickly, be less susceptible to contamination during bulk manufacture or less costly to continuously maintain in the laboratory.

30 Anti-Malignin antibody reacts specifically immunologically not only with the antigen Malignin, but also with the closely structurally related problems such as Astrocytin, Recognin L and Recognin M. Recognins are made by treating tumor cells or  
35 artificial cancer cells and separating the desired products. The Recognins may be used to prepare their

Chemoreciprocals, i.e., by contacting the Recognins on a support with body fluids. These Chemoreciprocals are useful for diagnostic and therapeutic purposes, i.e., for diagnosing and treating cancers.

5 The present invention will be further described with reference to the following Examples.

EXAMPLE 1

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Human spleens which had been surgically removed from non-cancer (thalassemic) patients were dissected as free as possible of other tissue. A fraction of a spleen was minced in neutral buffer, e.g. 0.0005M pH7 phosphate buffer. The mincing was performed at a reduced temperature to segregate the lymphocytes from the other material, the minced admixture was passed through a nylon net filter. The lymphocytes in the filtrate were then separated by a Ficoll/Hypaque gradient.

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The resulting lymphocyte admixture was cultured for a week in RPMI 1640 containing HEPES and glutamine, and 10% fetal calf serum. Thereafter, the cell culture supernate was tested for the presence of anti-Malignin antibody by immunoabsorption.

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Specifically, Malignin was covalently bound to bromacetylcellulose (BAC) to produce immobilized Malignin (BAC-Malignin). Lymphocyte culture supernate, 0.4 ml at 0°C, was added to 0.2 ml of BAC-Malignin. The 0.2 ml BAC-Malignin contained approximately 20 micrograms of immobilized Malignin which was an excess of antigen. The resulting BAC-Malignin-anti-Malignin antibody complex was washed three times with cold saline. To remove the bound antibody, the complex was then incubated with 0.25 M acetic acid at 37°C for two hours,

centrifuged at 3,000 rpm in a Beckman desk top  
5 centrifuge for 20 minutes, and the optical density  
(O.D.) of the clear acetic acid supernate was read at  
280 nanometers. The O.D. was converted to micrograms  
antibody protein per ml culture supernate using a  
1.46 gamma globulin conversion factor.

Additionally, the anti-Malignin antibody heavy  
chains were characterized by SDS-PAGE  
electrophoresis. The acetic acid supernate was  
10 neutralized, concentrated by pre-evaporation to a  
concentration of approximately 200 µg/ml and reduced  
with dithiothreitol so as to liberate the heavy  
chains. Thereafter, the anti-Malignin antibody heavy  
chains were examined by standard SDS-polyacrylamide  
15 gel electrophoresis (SDS-PAGE). Also on the sample  
electrophoresis gel in vivo produced anti-Malignin  
antibody heavy chains were characterised. The  
electrophoresis showed that the heavy chains from  
the in vivo and in vitro produced anti-Malignin  
20 antibodies were predominately of the mu type having  
molecular weight in the range of about 70K to about  
80K Daltons. These data suggest that anti-Malignin  
antibody is an IgM antibody regardless of whether it  
is produced in vivo or in vitro.

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EXAMPLE 2

Human spleens were surgically removed from  
Hodgkins' Disease patients and treated in the same  
30 manner as the Example 1 spleens were.

EXAMPLE 3

Normal human peripheral blood mononuclear cells  
35 were collected by the Ficoll/Hypaque gradient  
method. The B lymphocytes were then grown in culture

for one week and tested for anti-Malignin antibody described in Example 1.

EXAMPLE 4

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Hodgkins' Disease peripheral human peripheral blood mononuclear cells were treated according to Example 3.

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EXAMPLE 5

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Pokeweed mitogen (GIBCO), 1 or 20 microliters per milliliter cell culture fluid, was added to subcultures from those Examples 1, 2, 3 and 4

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lymphocytes cell cultures whose supernate contained a detectable level of anti-Malignin antibody. The pokeweed did not affect the production of anti-Malignin antibody by any of the lymphocytes when present at a level of 1 microliter per milliliter cell culture fluid. However, 20 microliters per

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milliliter cell culture fluid of pokeweed mitogen stimulated the production of anti-Malignin antibody in 5 out of 7 thalassemic spleen cell preparations (from less than about 10  $\mu$ g/ml to  $62.0 \pm 31.9$   $\mu$ g antibody protein/ml), in 9 out of 13 Hodgkins'

30

Disease spleen cell preparations (from less than about 10  $\mu$ g/ml to  $51.7 \pm 33.3$   $\mu$ g antibody protein/ml, but in none of the peripheral blood lymphocyte preparations (0 out of 6 normal and 0 out of 5 Hodgkins' Disease peripheral blood lymphocyte preparations). Additionally, it was also found that the ability of splenic and peripheral blood lymphocytes to produce anti-Malignin antibody, both unstimulated and in the presence of pokeweed mitogen, was lost within two to four weeks of cell culture.

EXAMPLE 6

Normal, anti-Malignin antibody producing,  
5 peripheral, human B lymphocytes were transformed by  
Epstein-Barr (EB) virus. Specifically, the  
lymphocytes were grown in the Example 1 cell culture  
medium. Viable cell counts were performed at 4-day  
intervals, the cell culture medium was changed  
weekly, and the culture volume was adjusted to  
10 maintain a cell density of  $4.5 \times 10^5$ /ml as long as  
possible.

Separating, P3-HRIK containing EB virus cell  
cultures were grown in medium 1640 supplemented with  
20% heat-inactivated fetal calf serum and 80  $\mu\text{g}/\text{ml}$  of  
15 neomycin sulfate. When the P3-HRIK cell culture  
reached a cell density of about  $2 \times 10^6$ /ml, the  
spent medium was removed by centrifugation and the  
cells were seeded at a concentration of  $3 \times 10^6$ /ml  
in 1640 medium containing 10% heat inactivated fetal  
20 calf serum. After a period of incubation of 10-12  
days at  $33^\circ\text{C}$  without media changes, the cells were  
removed by centrifugation at 10,000 rpm for 20  
minutes, the supernatant fluid was filtered through a  
0.45 $\mu$  Millipore (Trade Mark) membrane filter and  
25 concentrated to approximately 160 ml by  
ultrafiltration through a Diaflo UM-10 (Trade Mark)  
membrane. The concentrated fluid was then  
centrifuged in a Spinco SW 25.2 rotor for 2 hours at  
25,000 rpm. The pellets, consisting of subcellular  
30 components and EB virus were resuspended in growth  
medium containing 10% DMSO in 1/100-1/400 of the  
original volume of culture fluid.

To infect the lymphocytes with EB virus, a  
35 pellet of fresh lymphocytes containing approxiamtely  
 $4 \times 10^7$  cells was prepared. The lymphocyte pellet  
was resuspended in 0.3-0.5 ml of the EB virus

suspension. The lymphocyte EB virus suspension was  
incubated for an hour at 37°C with frequent  
agitation. The cells were then washed in 20 volumes  
of media and planted in 8.0 ml of medium in tissue  
culture flasks at 37°C and 5% CO<sub>2</sub>.

EXAMPLE 7

The EB virus transformed normal anti-Malignin  
10 antibody producing peripheral human B lymphocytes  
produced in Example 6 were found to continuously  
produce anti-Malignin antibody.

Fast binding anti-Malignin antibody production  
increased rapidly during the first three days for low  
15 density cultures and during the first five days for  
high density cultures (in both instances when the  
cell number was rapidly increasing). However, slow  
binding anti-Malignin antibody production for the  
first five days of lymphocyte culture was minimal --  
20 1/6 to 1/2 that of the fast binding anti-Malignin  
antibody production -- for both high and low cell  
density cultures.

However, from approximately the sixth day, when  
the cell number tended to stabilize, slow binding  
25 anti-Malignin antibody production increased. This  
pattern of fast and slow binding anti-Malignin  
antibody production in relation to cell division was  
observed whenever the medium was renewed or the cells  
were grown from an aliquot frozen in liquid nitrogen.

Furthermore, the addition of 0.04 µg/ml of  
purified Malignin peptide to growing cultures had no  
effect on the cell count, but was associated with an  
increase in the fast binding anti-Malignin antibody  
30 (5.9 ± 2.7 to 9.4 ± 4.5 µg/ml), but only in  
high density cell cultures.

Electrophoretic studies showed that the

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transformed lymphocyte anti-Malignin antibody was structurally similar to other anti-Malignin antibodies in that the heavy chains isolated from both mouse monoclonal anti-Malignin antibodies and human serum anti-Malignin antibodies resulted in patterns similar to those obtained from transformed lymphocyte anti-Malignin antibody heavy chains. Moreover, the electrophoretic patterns suggested that IgM was the predominant type of anti-Malignin antibody immunoglobulin.

Additionally, SDS-PAGE demonstrated that the fast and slow anti-Malignin antibody heavy chains are indistinguishable.

It was also noted that neither the fast, the slow, nor the total anti-Malignin antibody produced was related to the total immunoglobulin, the total IgM or the total IgG produced.

Immunofluorescent activated cell sorting and indirect immuno-alkaline phosphatase staining of an oat cell lung carcinoma indicate that the in vitro anti-Malignin antibody was transformed from human lymphocytes binds in a manner similar to anti-Malignin antibody from human serum.

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CLAIMS:

1. A process for producing human lymphocyte anti-cancer Recognin antibody wherein the cancer Recognin is a product, derived from cancerous tumour tissue or cells, which is characterized by forming a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, by being soluble in water and aqueous solutions and having a spectrophotometric absorption peak wave length of 280 mu and a molecular weight of from about 3,000 to 25,000, and further characterized by having an amino acid residue composition characterized by high proportions of glutamic and aspartic acids and high ratios of glutamic and aspartic acids to histidine comprising the steps of:

- a) obtaining a population of human lymphocyte cells;
- b) selecting a subpopulation of the population of human lymphocytes wherein the subpopulation produces anti-cancer Recognin antibody; and
- c) treating the subpopulation of anti-cancer Recognin antibody producing human lymphocytes in a manner effective to enhance anti-cancer Recognin antibody production.

2. A process as claimed in claim 1 wherein the population of human lymphocytes are obtained by a process comprising:

- i) surgical removal of a part of a spleen; and
- ii) isolating individual lymphocyte cells from the spleen.

3. A process as claimed in claim 1 wherein the population of lymphocytes are obtained by separating viable lymphocytes from a blood sample.

5

4. A process as claimed in any one of the preceding claims which further comprises growing the lymphocytes in a cell culture.

10

5. A process as claimed in any one of the preceding claims wherein the subpopulation selection comprises testing the lymphocyte culture media supernate for the presence of the anti-cancer Recognin antibody by immunoabsorption of the antibody onto immobilized Recognin antigen.

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6. A process as claimed in any one of the preceding claims wherein the treating step comprises adding an effective amount of pokeweed mitogen to the lymphocyte cell culture, preferably at least 10 ug/ml of pokeweed mitogen.

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7. A process as claimed in any one of claims 1 to 5 wherein the treating step comprises transforming the lymphocyte cell subpopulation by EB virus.

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8. A process according to claim 1 which further comprises isolating the anti-cancer Recognin antibody by adsorbing the anti-cancer Recognin antibody onto immobilized Recognin.

9. A process as claimed in any one of the preceding claims wherein the cancer Recognin is Malignin.

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10. A process as claimed in claim 8 which

further comprises modifying the isolated anti-cancer Recognin antibody by adding a chemotherapeutic agent to the antibody or by adding a signal emitter to the antibody.

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11. A process as claimed in claim 10 wherein the signal emitter is fluorescent, or creates a radiological contrast image in a tissue environment, or is a nuclear magnetic resonance spin label.

10

12. A composition comprising human monoclonal anti-Malignin antibody-Fast or a purified fraction thereof, whereby the antibody or a purified fraction thereof attaches to cancerous cells, the cells comprising Malignin; and can thereby be detected by visible or signal-emitting means attached to the antibody, the Malignin being derived from brain tumour cells, and which forms a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, which is soluble in water and aqueous solution having an acid or neutral pH, and insoluble at an alkaline pH, and has a spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-

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APPROXIMATE NO. OF RESIDUES

	Aspartic Acid	9
5	Threonine	5
	Serine	5
	Glutamic Acid	13
	Proline	4
	Glycine	6
10	Alanine	7
	Valine	6
	1/2 Cysteine	1
	Methionine	2
	Isoleucine	4
15	Leucine	8
	Tyrosine	3
	Phenylalanine	3
	Lysine	6
	Histidine	2
20	Arginine	5
		89

ammonia and the amino acids cysteic, hydroxyproline,  
norleucine, isodesmosine, lysinonorleucine and  
gamma-aminobutyric acid being absent in detectable  
amounts.

13. A composition comprising human monoclonal  
anti-Malignin antibody-Slow or a purified fraction  
thereof, whereby the antibody or a purified fraction  
thereof attaches to cancerous cells, the cells  
comprising Malignin; and can thereby be detected by  
visible or signal-emitting means attached to the  
antibody, the Malignin being derived from brain  
tumour cells, and which forms a single line  
precipitate with its specific antibody in  
quantitative precipitin tests and Ouchterlony gel

5 diffusion tests, which is soluble in water and aqueous solution having an acid or neutral pH, and insoluble at an alkaline pH, and has a spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-

APPROXIMATE NO. OF RESIDUES

10	Aspartic Acid	9
	Threonine	5
	Serine	5
	Glutamic Acid	13
	Proline	4
15	Glycine	6
	Alanine	7
	Valine	6
	1/2 Cysteine	1
	Methionine	2
20	Isoleucine	4
	Leucine	8
	Tyrosine	3
	Phenylalanine	3
	Lysine	6
25	Histidine	2
	Arginine	5
		89

30 ammonia and the amino acids cysteic, hydroxyproline, norleucine, isodesmosine, lysinonorleucine and gamma-aminobutyric acid being absent in detectable amounts.

35 14. A composition comprising human monoclonal anti-Malignin antibody-Fast and Slow or a purified fraction thereof, whereby the antibody is cytotoxic to and kills the cancer cells, the cells comprising

Malignin, whereby the antibody or a purified fraction thereof attaches to cancerous cells and can thereby be detected by visible or signal-emitting means attached to the antibody, the Malignin being derived from brain tumour cells, and which forms a single line precipitate with its specific antibody in quantitative precipitin tests and Ouchterlony gel diffusion tests, which is soluble in water and aqueous solution having an acid or neutral pH, and insoluble at a alkaline pH, and has an spectrophotometric absorption peak wave length of 280 m $\mu$ , a molecular weight of about 10,000, and an amino acid composition approximately as follows:-

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APPROXIMATE NO. OF RESIDUES

	Asparatic Acid	9
	Threonine	5
5	Serine	5
	Glutamic Acid	13
	Proline	4
	Glycine	6
	Alanine	7
10	Valine	6
	1/2 Cysteine	1
	Methionine	2
	Isoleucine	4
	Leucine	8
15	Tyrosine	3
	Phenylalanine	3
	Lysine	6
	Histidine	2
	Arginine	5
20		89

ammonia and the amino acids cysteic, hydroxyproline, norleucine, isodesmosine, lysinonorleucine and gamma-aminobutyric acid being absent in detectable amounts.

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15. A composition as claimed in any one of claims 12, 13 or 14 wherein the antibodies are predominantly IgM.

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16. A cell line comprising a cell wherein the cell produces monoclonal anti-Malignin-antibody, all of the ancestors of the cell are selected from the group consisting of human cells, cells derived only from human cells and combinations thereof and the cell is not a hybridoma.

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17. A cell line as claimed in claim 16 wherein  
the cell has the appearance of a human lymphocyte.

5       18. A cell line as claimed in claim 16 wherein  
the cell is a cell which is virally transformed by EB  
virus.

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BOULT, WADE & TENNANT

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9th December, 1986

Dear Sirs,

European Patent Application No. 86308352.3  
in the name of Dr. Samuel Bogoch

I now file herewith the following documents in order to complete the formalities in respect of the above-identified Patent Application:-

- (i) Authorisation of Agent;  
(ii) Certified Copy of United States Patent Application Serial No. 794356.

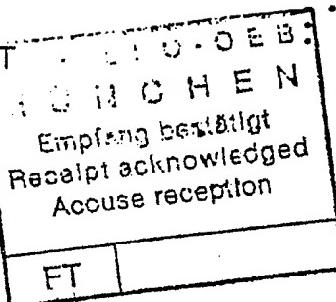
It has also come to my attention that certain typographical errors occur in the Specification of this Application. I therefore request that the following amendments should be made to the Specification:-

- Page 5, line 20: Delete "49" and replace with "89";  
Page 11, line 9: Correct the spelling of "genetic";  
Page 11, line 33: Delete "problems" and replace with "antigens";

Sauer J. A. 9 JAN. 1987

CONT.....

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Reçu:

18 DEC. 1986

- 2 - 9th December, 1986

Page 13, line 10:

Correct the spelling of  
"perevaporation";

Page 15, line 33:

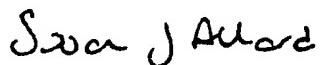
Delete "infect" and replace  
with "treat";

Page 16, line 1:

Insert the word "treated"  
after the word "virus"

Kindly acknowledge safe receipt of this letter and  
enclosures by signing and returning the enclosed  
acknowledgement form to me.

Yours faithfully,



ALLARD; Susan Joyce,  
Representative for the Applicants